TEST PROCEDURE FOR THE UT / MPI OF THE GPS BOGIE FRAMES.

Issue 3	Date 28/08/2003	Revision A
Purpose :- To specify the test procedure that is to be utilised for the inspection of the GPS bogies frames for cracking.		

Scope :- Applies to all GPS 20 bogies

Approval & Authorisation

	NAME	PCN No	SIGNATURE
APPROVED BY	Merrick E P Abrahams		

Merrick 28/02/12.

Issue No	Revision	Date	Comments
3	A	28/08/03	Re-write to include MPI procedure.

CONTENTS

Introduction

The document Inidam P-UT-26-02 dated 14th June 2000 has been re-written / updated to include the MPI inspection that is a requirement for the crack detection on all types of the GPS bogies.
There are other areas where cracks have since been detected and these have been included.
This document should form the basis for any crack detection requirements.
This procedures contained within the document cannot be guaranteed to detect all defects in the bogie frames, and the information should be treated as current best practise only.
The purpose of this document is to assist the Owners in ensuring the vehicles are safe to operate.
Owners requiring more specific details are advised to contact one of the Engineering Consulting companies.

PART I	TEST PROCEDURE FOR THE ULTRASONIC EXAMINATION TO DETECT CRACKING IN PLATE ADJACENT TO 'T' BUTT WELD IN FERROUS MATERIAL REFERENCED TO BS EN 1714, 1998.

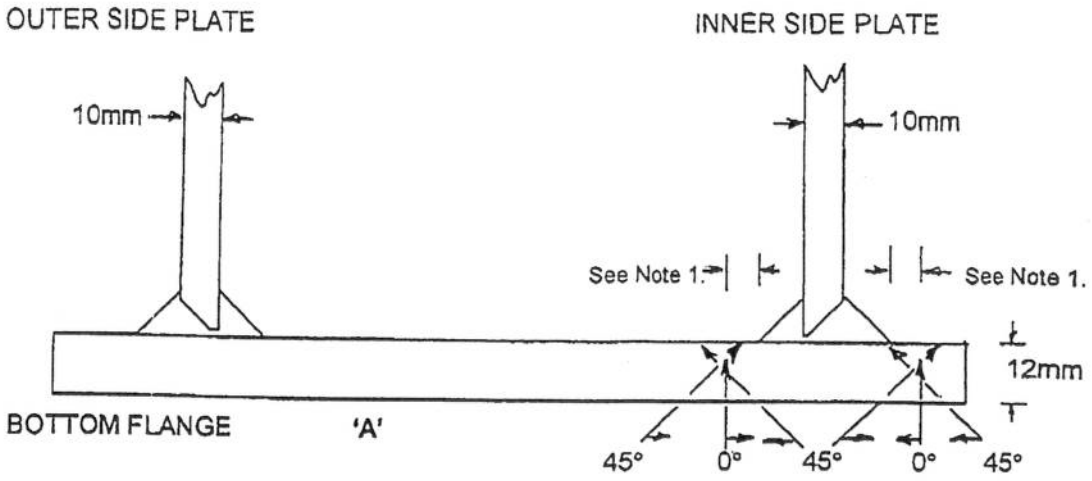
1.0	INTRODUCTION
1.1	The following procedure lays down the requirements for the manual ultrasonic inspection of plate material to detect cracking adjacent to 'T' Butt Welds in 10mm to 12mm material (see figure 2 page 8).
2.0	**SCOPE**
2.1	The requirements of this procedure shall take guidance from BS EN 1714, 1998. Where any requirements of this procedure are in conflict with BS EN 1714, 1998, then the requirements of this procedure shall prevail.
2.1.1	The requirements contained in this procedure are not exhaustive in content, reference should be made to BS EN 1714, 1998, to clarify any test requirement, if deemed necessary by the operator.
2.1.2	This test procedure details the requirements to detect possible cracking propagating from the root and weld toes into the parent material. Scanning of the affected area shall be undertaken on painted surfaces. Reference to figure 2 page 8 for suspect areas covered by this procedure.
3.0	**REFERENCES**
	The following standards are referred to in this procedure:-

3.1	BS EN 1714:998	- -	Ultrasonic examination of welded joints.
	BS EN 12223:2000	- -	NDT Ultrasonic examination specification for Block No. 1.
	BS EN 27963:1992	- - -	Calibration Block No. 2 for Ultrasonic examination of welds.
	EN12668-1:2000	- - -	Assessing performance characteristics of Flaw Detection Equipment and Probes.
	BS EN 1330-4:2000	- - -	NDT Terminology for Ultrasonic Testing.
	BS EN 10160:1999	- - -	Ultrasonic testing of Steel plate

4.0	**PERSONNEL**
4.1	All Ultrasonic personnel shall hold PCN Level 2 certification in the weld configuration under test. Certification shall be made available to the client for their examination. The operators qualifications for T butt minimum 3.8.
5.0	**EQUIPMENT**
5.1	Ultrasonic flaw detector equipment having 'A' scan presentation shall be used. Flaw detection equipment shall be calibrated to EN12668-1, 2000 at not more than 12 monthly intervals, certification shall be made available to the client on request.
5.1.1	On site the operator shall carry out checks for time base, and amplifier linearity prior to the daily start of inspection. Reference EN12668-1, 2000 *All equipment to be calibrated in accordance with the relevant Group Standards and auditable records produced regarding calibration.*
5.2	**PROBES**
5.2.1	The following probes, as a minimum requirement shall be available at the Ultrasonic test site. 10mm diameter Twin Crystal ---------- 0° and 45°. The above probes shall have a frequency of between 4 and 5 MHz, each probe shall bear a unique number, and be marked with its angle and frequency.
5.2.2	Check by the operator shall be made on a daily basis for probe wear and damage, and in addition checks on index point, and probe angle as required by BS 4331, part 3, 1974.
5.3	**CALIBRATION BLOCKS**
5.3.1	The following blocks shall be available to the operator at the time of test:- A4 and A2 The above blocks shall meet the requirements of BS EN 12223, 2000 and BS EN 27963, 1992. The A4 block shall be immediately available to the operator at all times Ultrasonic inspection is being undertaken.
5.4	**COUPLANT**
5.4.1	Couplant will be of a cellulose water paste type. Other types may be acceptable for use provided they are of a non-corrosive, and easily removable nature.

6.0	**SURFACE CONDITION**
6.1	The scanning surface will have had the paint system applied. All paint shall be fully adhered to the base material and be of a smooth even texture. All flaking paint shall be removed prior to inspection. Prior to inspections all grit, dirt, etc. shall be removed from the painted surface for the full extent of the inspection area.
7.0	**DATUM POSITIONS**
7.1	Datum positions shall be marked on each weld, where measurements are required, i.e. reportable defects, areas of inspection limitations etc. Reference should be made to Figure 3 and 4 for their respective locations.
7.2	The maintainer prior to examination shall agree all datum positions.
8.0	**DISTANCE AMPLITUDE CORRECTION (D.A.C)**
8.1	Due to anticipated beam paths and the nature of examination no distance amplitude correction will be required.
9.0	**MATERIAL ATTENUATION FACTOR**
9.1	Due to the short beam paths used under this procedure attenuation / transmission factor of 4dB shall be assumed. This shall be added to all sensitivity relative to the 3mm S.D.H. (Shearwave only)
10.0	**REFERENCE SENSITIVITY**
10.1	Reference sensitivity shall be as follows:-
(1)	Compressional Probe – First backwall echo 80% from defect free area of plate.
(2)	Shearwave Probe – 3mm diameter side drilled hole giving best response 80% full screen height.
11.0	**TEST SENSITIVITY**
11.1	Test sensitivity shall be as follows:-
(i)	0° Probe - Reference Sensitivity + 14dB of gain.
(ii)	45° Probe - Reference Sensitivity + 10dB of gain.
	Test sensitivity's shall be referenced to the 20mm thickness for compressional probe and 50mm radii for shearwave probe of an A4 Block.
NOTE	Items (ii) require 4dB compensation factor added as section 9.0.

12.0	**SCANNING PROCEDURE**
12.1	Scanning of all welds shall be by rasters, each adjacent raster scan shall not be made at more than 80% of the probe crystal diameter.
12.2	Scanning speed shall not exceed 150mm per second.
12.3	Examination from the surface as indicated in Figure 1 shall be undertaken to the required welds, to detect indications in both the Longitudinal and Transverse directions to the weld axis.
12.4	See figure 1 for specific scanning requirements.
12.5	Sizing of all cracking shall be undertaken by the maximum amplitude technique, to record length and through wall width of cracking. Where defect sizing records a dimension of 3mm or less this shall be reported as maximum 3mm dimension.
13.0	**REPORTING**
13.1	Reports of all welds shall as a minimum requirement contain the following information:- Wagon Number Bogie Number Bogie Corner Number Project Identification Date of Test Operators name, signature and certificate number Any details of test limitations Details of any reportable defects, size, location and extent. Test sensitivity used Reference to procedure used Limitations or deviation from test procedure See typical test report sheet to be completed page 13
13.2	The Ultrasonic operator shall issue an inspection sheet for each bogie examined, reference Figure 5 (page 11) of this procedure.

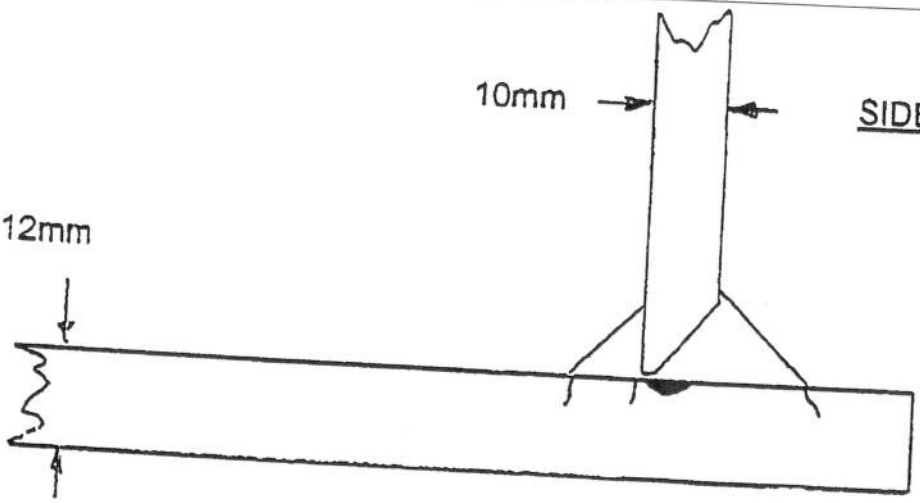


NOTE 1. 10mm minimum overlap with 0° probe scan.

NOTE 2. Scanning typical for both inner and outer side plates.

FIGURE 1

	SCANNING PROCEDURE
1	Initial 0° probe examination of weld fusion line to be carried out from adjacent plate surface 'A', weld reinforcement to be overlapped by 10mm minimum. All indications attributed to possible cracking to be marked for further investigation by 45° sherwave scans.
2	Investigation of all suspect areas to be carried out by 45°-angle probe scans from all directions to confirm defect type size and extent etc.
3	Areas of plate inclusion shall be ignored unless these adversely affect the examination. Where inclusions are found to preclude full examination these shall be reported as a limitation to test.
4.	Calibration for beam path shall be as follows:- 0° Probe – 20mm full screen expansion 45° Probe – 50mm full screen expansion

	
	Figure 2
Remarks	Cracking from the toes and root into the parent metal to welds as detailed in Figure 2 above.
	This test procedure details the requirements to detect any areas of cracking by primarily examination with compressional scans and confirmation by 45°-angle probe. Cracking as indicated above may lie in the longitudinal or transverse plane relative to the axial direction of the weld.

TYPICAL PLAN AND SIDE ELEVATION OF GPS 20 BOGIES

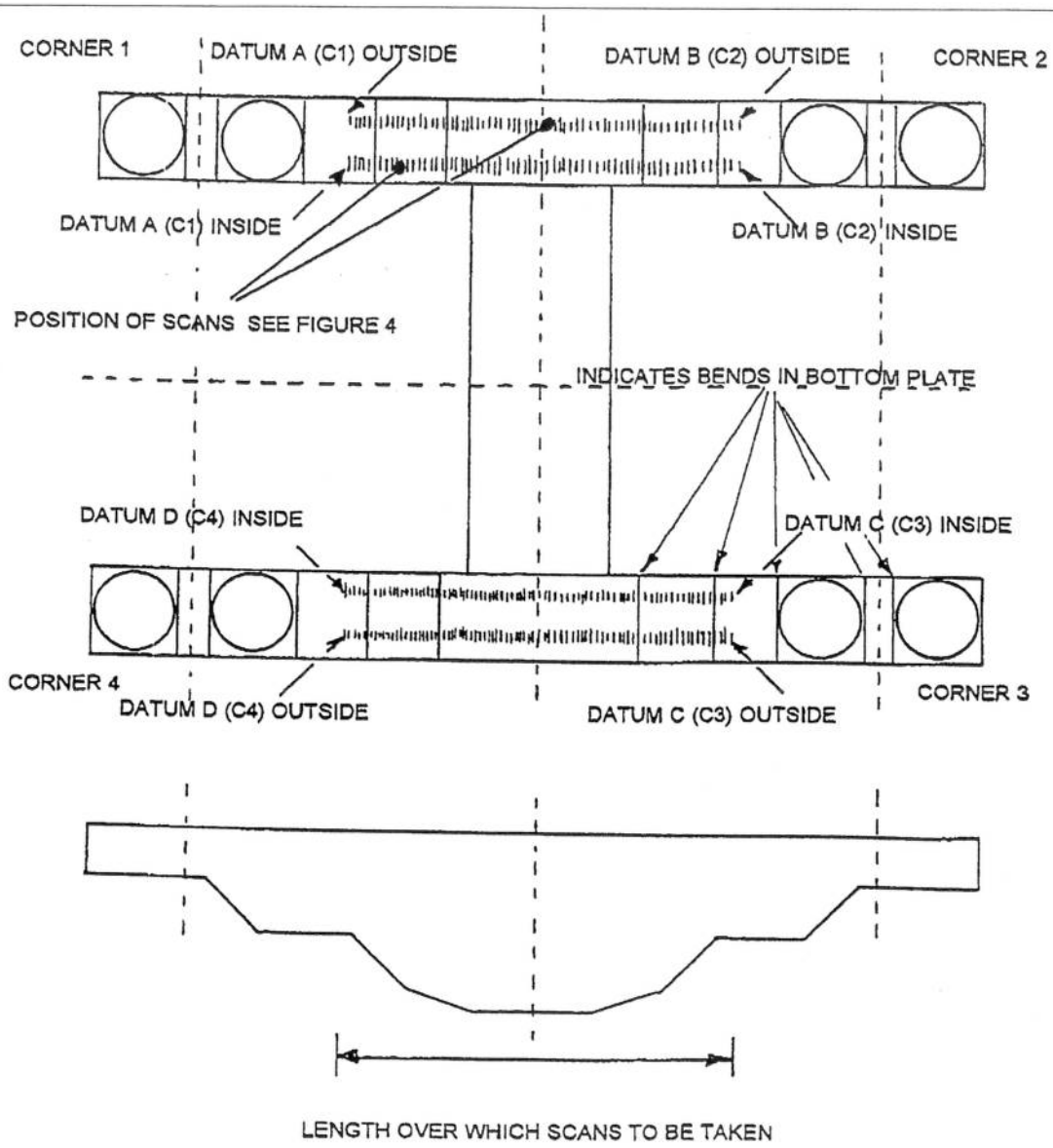


Figure 3

LOCATION OF SCANNING

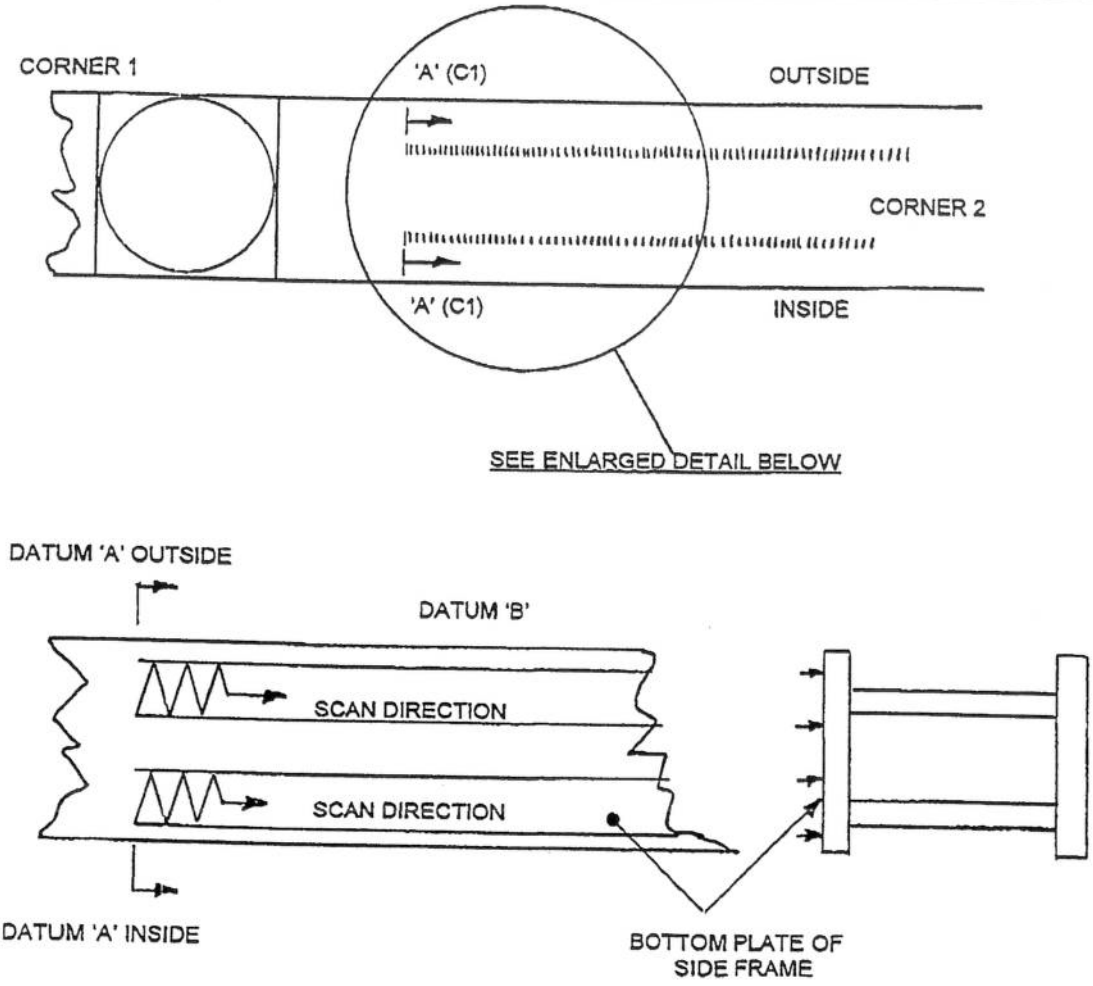


Figure 4

EXAMINATION COMPLETED BY RASTER SCANS TYPICAL OF FOUR LOCATION TO EACH BOGIE

INSPECTION SHEET FOR GPS20 SIDE FRAMES

Wagon number:- Bogie number:- Date inspected:-

Operator name:- Operators certification number:-

UAT procedure:- Test sensitivity:-

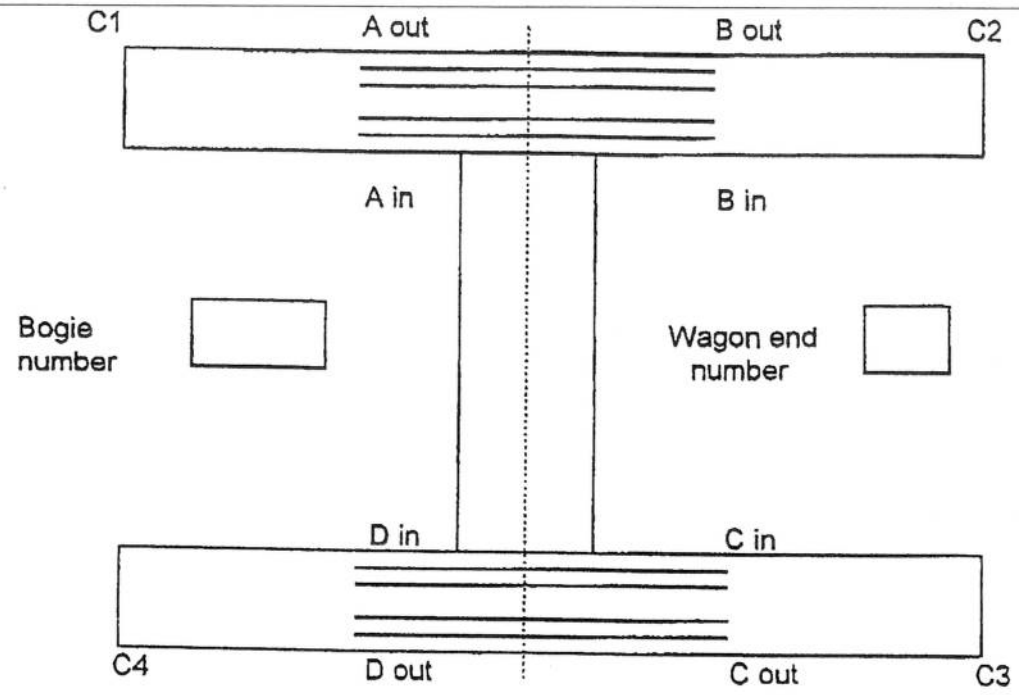
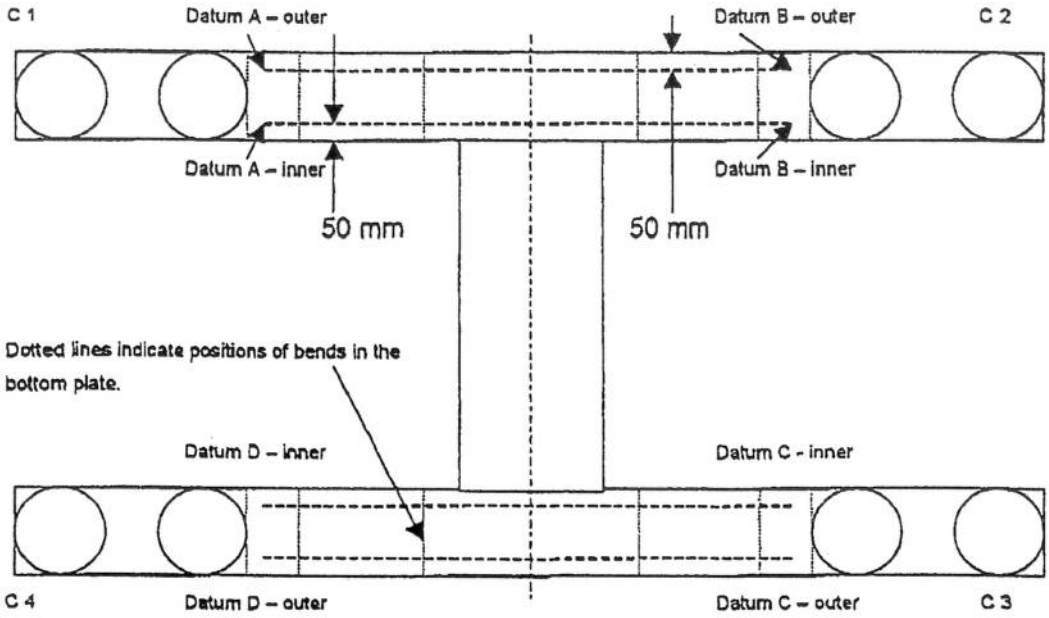


Figure 5

Datum points A out and in, B out and in, C out and in, and D out and in.

Any defects are to be marked on the drawing above, together with distance from nearest datum and notes about size and extent of defect.

Note that the tramlines on the sketch above denote the extents of the scan weave. If defects are found inside the boundaries of the weave it may be necessary to sketch a blow up of the area to mark it's location accurately.
Use the space below to do so.

	VISUAL INSPECTION OF GPS BOGIES (Figure 6)
1.	The Health and Safety at Work practices of the assembly shop /depot where this work is to be carried out must be understood and enforced whilst working to this procedure.
2.	This inspection sheet is for GPS 20 bogies and is for the underside of the side-frames, between the inner spring nests, see diagram.
	
	Figure showing underside of bogie frame.
	Visually inspect both side frames along the inner and outer edges of the bottom plate with an inspection width of 50mm all the way along between datum's.
	These datum's are located just inside the inner spring nests.
	Note any defects, cracks, indents, gouge marks, etc, recoding their positions on a pro-forma inspection sheet together with the distance from the nearest datum.
	MPI inspect any defects found. Record details as below and report to Network Rail.
	Inspectors name:- Date inspected:- Wagon number:- Bogie number:- Defects found:-
	To aid inspection it is advised that the bogie has it's corners numbered, as indicated on the figure above.

Typical Test Report For UT

Ultrasonic Test Report

Client	Location of Item	Ref:

Order No.	Date of Test	Report No.	Date of Report

Description of Item Item: Part of Item Tested Identification: Type of Material: Surface Condition: Procedure: Acceptance Criteria: Inspector:	 Satisfactory Inidam – TP-UT-26-03 Factual To Clients Requirements PCN Level ii 3.8
Ultrasonic Flaw Detection: Equipment: Frequency: Probe Type: Ref: Block: Couplant: Sensitivity:	 Serial No. Calibration No. 5 Mhz 10mm Dia. 0 deg CD & 45, 60 & 70deg MAP BS EN 27963 Cellulose Paste 80% FSH plus 10dB 3mm SDH, & DAC Compression Plus 14dB
Results	

	Trailer	Bogie	Section	Bolster	

The welds to the above mentioned trailers were all found to be free from any internal recordable indications.

Printed Name _____ **Signature** _____

PART 2	TEST PROCEDURE FOR THE MAGNETIC PARTICLE INSPECTION / EXAMINATION TO DETECT CRACKING

	Introduction	
	The following procedure lay down the requirement for magnetic particle inspection.	
1.0	**Scope**	
1.1	Magnetic particle inspection for detecting surface and near surface flaws in ferritic steels.	
1.2	Where welds are examined, a minimum of 15mm of the base plate metal either side of the weld will also be examined.	
2.0	**Related Standards**	
2.1	This procedure is based on and meets the requirements of the following standards.	
a)	BS EN 1290 : 1998 – Method for magnetic particle inspection.	
b)	BS EN 1291 : 1998	
c)	BS EN 25817 : 1992	
2.2	Where this procedure is required to meet the requirements of other standards, any variations will be shown on an attached inspection summary.	
3.0	**Personnel Qualifications**	
3.1	All operators will be qualified and certificated to at least level II as required by ISO 9712 : 1992 (Non-Destructive Testing) – qualification and certification of personnel).	
3.2	Certification will normally be to PCN/ASME/ASNT requirements as appropriate.	
4.0	**Consumables**	
4.1	Black Magnetic Ink White Paint Cleaner	Johnson & Allen Neocol B Johnson & Allen Neopaint NPT 16 Johnson & Allen JAC2 – SHF
5.0	**Equipment**	
5.1	Magnaflux AC York, non-variable current.	
5.2	Efficiency of the equipment shall be such that a load of not less than 4. 5 kg can be lifted with a pole spacing of 300mm.	

6.0	**Surface preparation**
6.1	The test area will be free of rust, scale, grease or any foreign matter that may hinder detection and interpretation of defects.
6.2	The test may be carried out on painted surface providing that the paint is evenly applied and not greater than 50 microns thick.
7.0	**Inspection Method**
7.1	A thin coating of white paint shall be applied to the test surface. Contrast paint must be applied evenly, avoiding uneven laps or ridges of paint.
7.2	The AC Yoke shall be placed across the test area and the current applied.
7.3	Magnetic ink shall be sprayed onto the test area between the poles of the yoke and examination of the surface for indications shall then take place.
7.4	The yoke shall then be turned through 90 deg and the test repeated, to ensure full coverage of the test area.
7.5	The flux density is to be ensured by the use of Burma Castrol Brass type flux indicator.
8.0	**Viewing Condition**
8.1	The level of lighting at the inspection point should exceed 500 Lux. This is equivalent to an 80W strip light at 450mm.
9.0	**Acceptance Criteria**
9.1	BS EN 25817 : 1992 Cat B
10.0	**Defect Repair**
10.1	Unacceptable defects will be blended or removed and the test repeated to ensure complete removal.
10.2	Where welding is required in the repair area, it will be carried out to approved procedures by approved welders.
11.0	**Records**

Typical Test Report For Magnetic Testing

Magnetic Test Report

Client	Location of Item	Ref:

Order No.	Date of Test	Report No.	Date of Report

Description of Item	
Item:	Off GPS20 Bogies
Part of Item Tested	1005 of all welds
Identification:	See below
Type of Material:	Ferritic Steel
Surface Condition:	Satisfactury
Procedure:	Inidam TP-UT-03,
Acceptance Criteria:	BS EN 1291: 1998
Inspector:	Name _____ PCN Level II; 38
Magnetic Particle Inspection:	
Equipment:	Magnaflux Y6 Yoke
Method of Magnetisation:	AC Induced Magnetic Flux
Test Media:	J & A Black Ink BS 4069
Background Paint:	J & A White Paint BS 5044
Type of Test Strip:	Burmah Castrol type 1 (Brass)

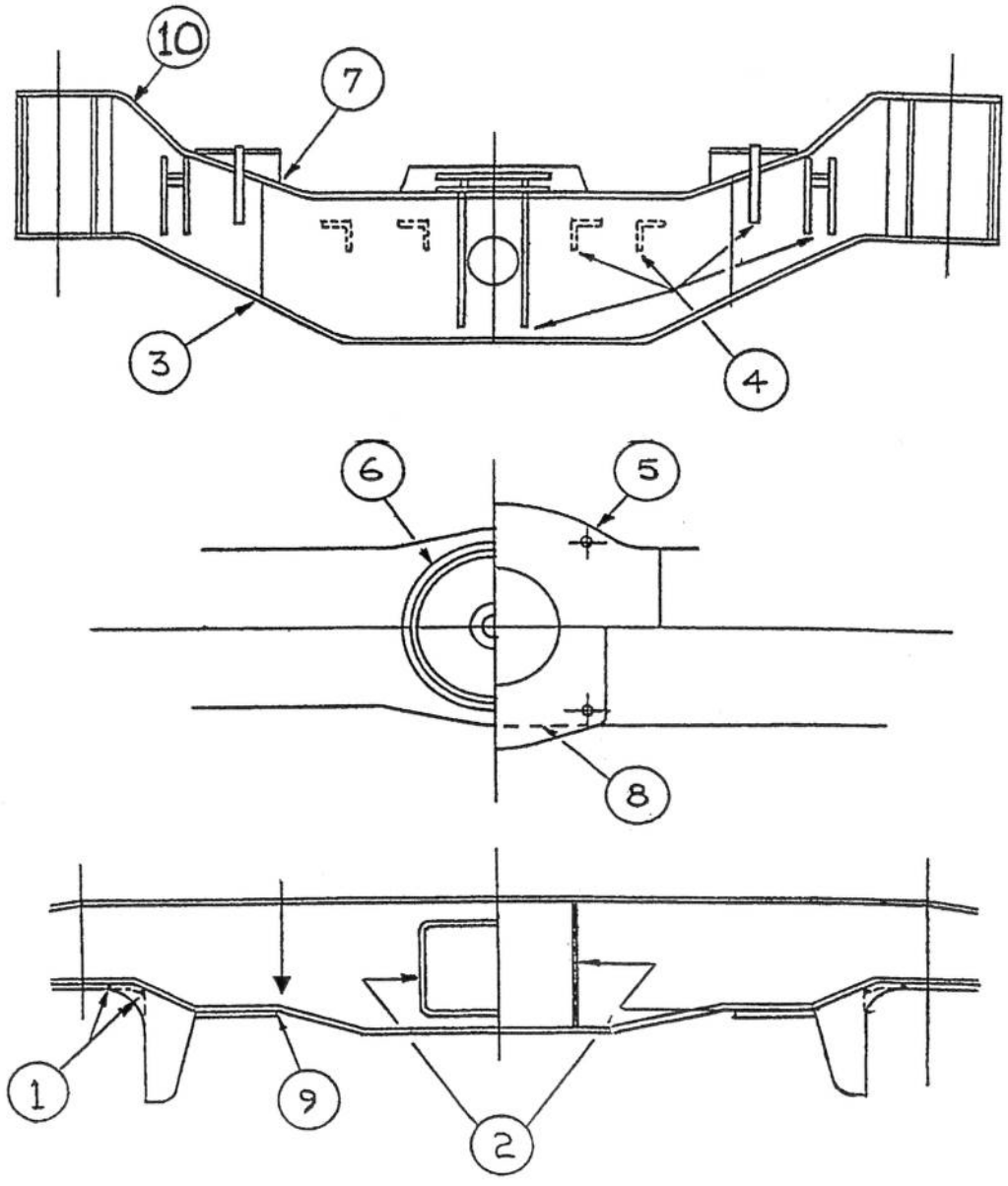
Results

	Trailer	Bogie	Section	Bolster		

The bolster, side plates and bottom plate welds have all been subjected to examination to the above mentioned bogies by the method stated and were all found to be free from any surface breaking indications.

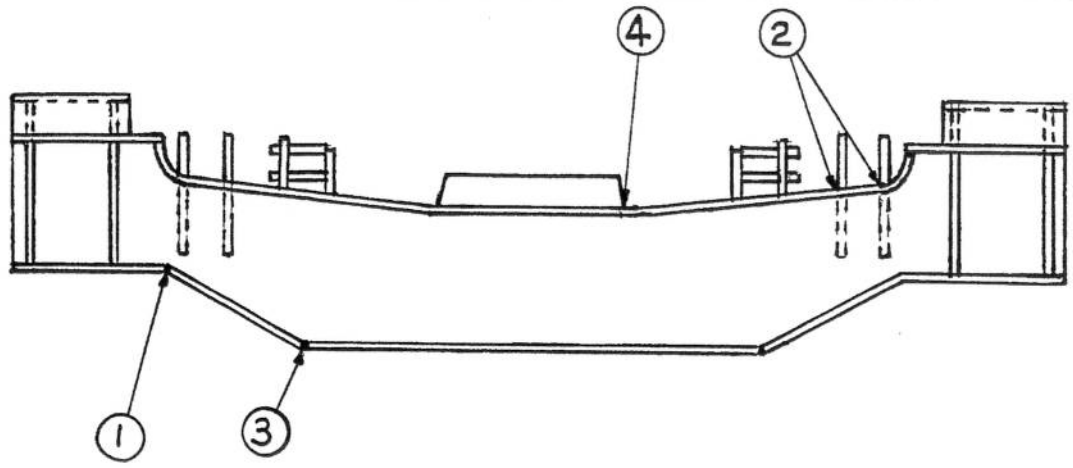
Printed Name _____ **Signature** _____

TYPICAL INSPECTION AREAS	(Figure 7)
1. WELDS IN SIDEFRAME / HORN GUIDE	6. WELD AROUND BOTTOM CENTRE PIVOT.
2. WELDS IN SIDERFRAME CLOSURE PLATE.	7. WELDS AT SIDEBEARER PLATFORM / BOLSTER OR SIDEBEARERS / BOLSTER.
3. PARENT METAL IN BOLSTER SIDE AND BOTTOM PLATES AT CORNER OF INSET PLATE.	8. WELD AT CENTRE PIVOT PLATE ? BOLSTER.
4.PARENT METAL IN BOLSTER SIDE PLATES AT TOP AND BOTTOM EDGES OF BRAKE BRACKETS.	9. PARENT METAL IN SIDEFRAME BOTTOM PLATE AT INNER SPRING SEATS.
5. BOLSTER TOP PLATE AND CENTRE PIVOT HOLES.	10. TOP & SIDE PLATE IN THIS VACINITY.

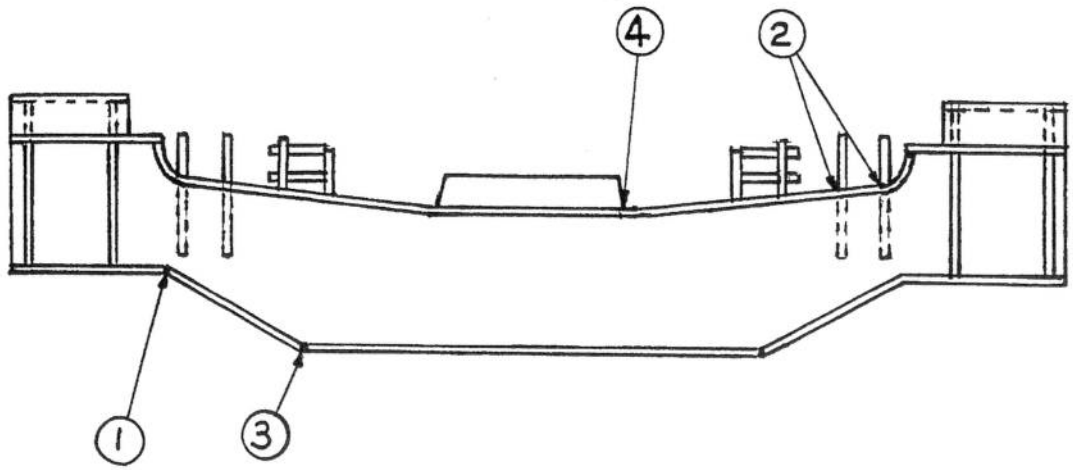


Part 3 Inspection Record Sheets (Figure8 Tread Brakes)

VEHICLE NUMBER	BOGIE NUMBER
INSPECTION AREA	
1. CROSS WELDS IN BOTTOM PLATE	3. BOLSTER SIDE PLATE.
2. BOLSTER SIDE PLATES AT TOP & BOTTOM EDGES OF ALL BRAKE BRACKETS	4. WELD BETWEEN THE BOTTOM OF THE SIDE BEARERS & BOLSTER.
BOLSTER SIDE 1 MARK UP ANY REJECTED LOCATION BOGIE FAILED / PASSED INSPECTION SIGNATURE DATE	

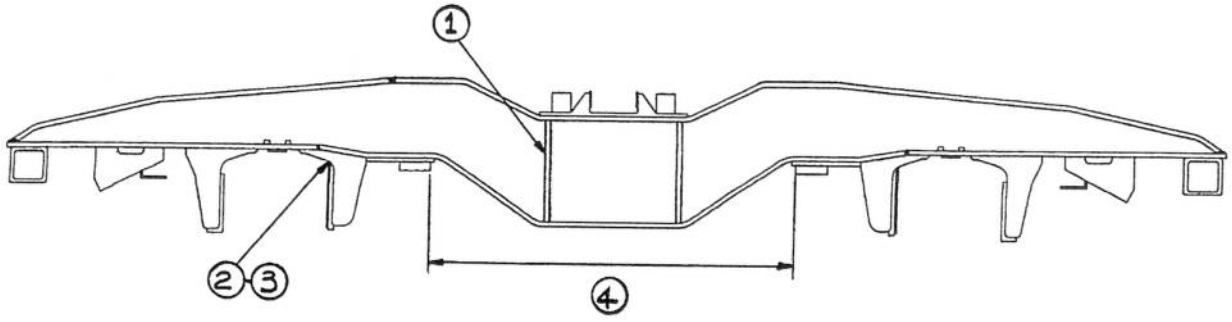


BOLSTER SIDE 2 MARK UP ANY REJECTED LOCATION BOGIE FAILED / PASSED INSPECTION SIGNATURE DATE	

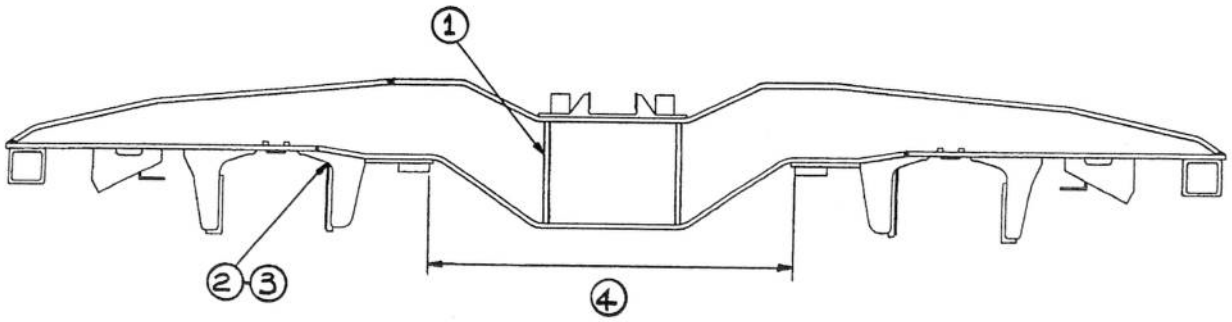


Part 3 Inspection Record Sheets (Figure9 Tread Brakes)

VEHICLE NUMBER	BOGIE NUMBER
INSPECTION AREA	
1. VERTICAL WELDS AT CLOSEURE PLATE	3. WELD AT HORN GUIDE FACE PLATE.
2. HORN GUIDE SIDEPLATES	4. BOTTOM PLATE AND WELDS, SIDE FRAME BOTH SIDES.
SIDEFRAME 1 BOGIE FAILED / PASSED INSPECTION SIGNATURE	MARK UP ANY REJECTED LOCATION DATE



SIDEFRAME 2 BOGIE FAILED / PASSED INSPECTION SIGNATURE	MARK UP ANY REJECTED LOCATION DATE

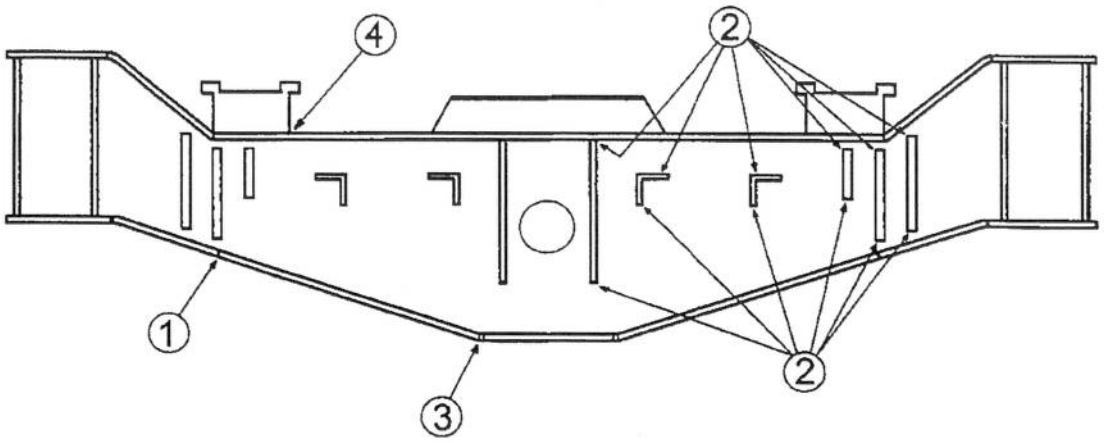


Part 3 Inspection Record Sheets (Figure10 Tread Brakes)

VEHICLE NUMBER	BOGIE NUMBER
INSPECTION AREA	
1. CROSS WELDS IN BOTTOM PLATE	3. BOLSTER SIDE PLATE.
2. BOLSTER SIDE PLATES AT TOP & BOTTOM EDGES OF ALL BRAKE BRACKETS	4. WELD BETWEEN THE BOTTOM OF THE SIDE BEARERS & BOLSTER.

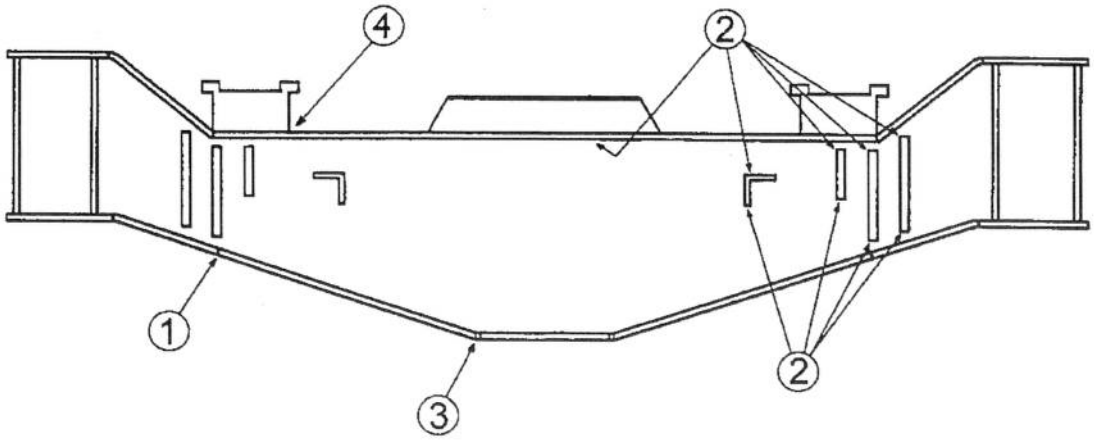
BOLSTER SIDE 1 MARK UP ANY REJECTED LOCATION
BOGIE FAILED / PASSED INSPECTION
SIGNATURE DATE

MARK UP ANY REJECTED LOCATION



BOLSTER SIDE 2 MARK UP ANY REJECTED LOCATION
BOGIE FAILED / PASSED INSPECTION
SIGNATURE DATE

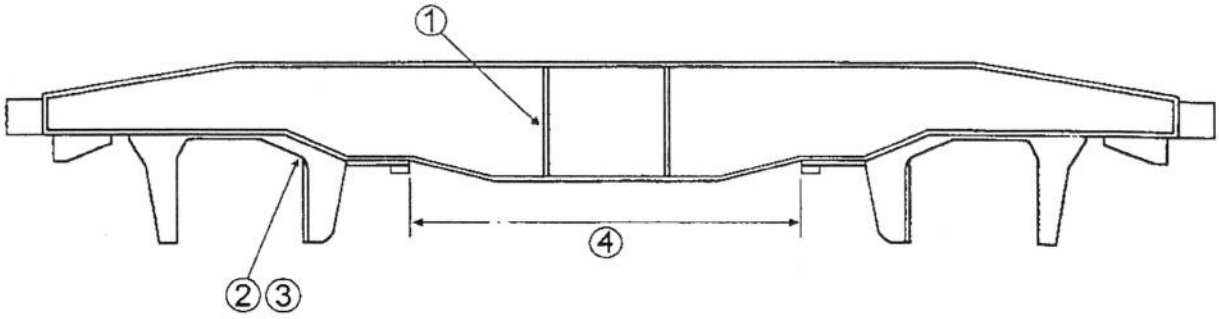
MARK UP ANY REJECTED LOCATION



Part 3 Inspection Record Sheets (Figure 11Tread Brakes)

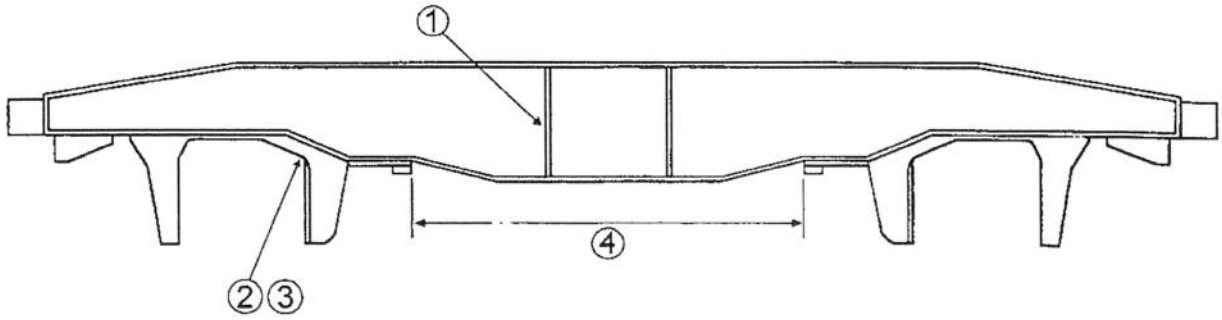
VEHICLE NUMBER	BOGIE NUMBER
INSPECTION AREA	
1. VERTICAL WELDS AT CLOSEURE PLATE	3. WELD AT HORN GUIDE FACE PLATE.
2. HORN GUIDE SIDEPLATES	4. BOTTOM PLATE AND WELDS, SIDE FRAME BOTH SIDES.
SIDEFRAME 1 BOGIE FAILED / PASSED INSPECTION SIGNATURE	MARK UP ANY REJECTED LOCATION DATE

MARK UP ANY REJECTED LOCATION



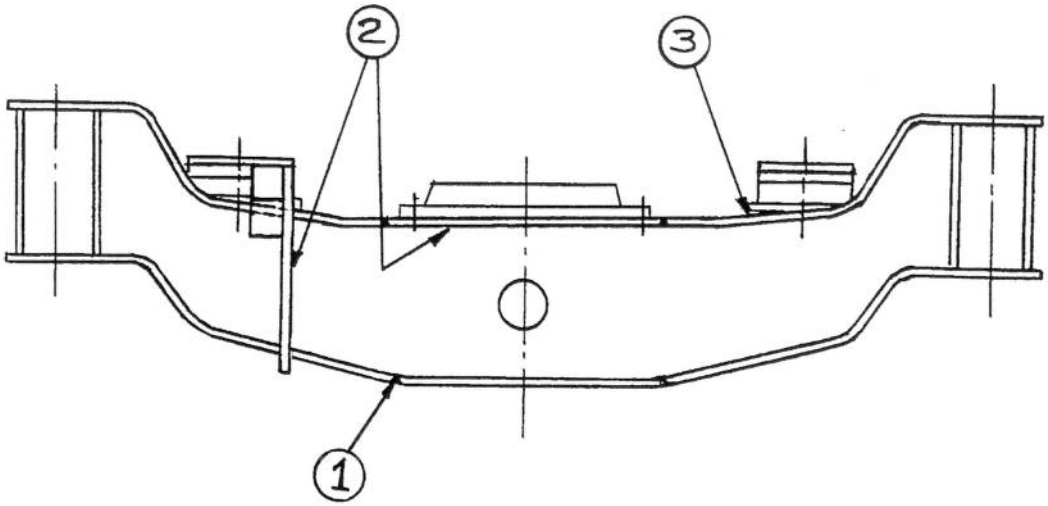
SIDEFRAME 2 BOGIE FAILED / PASSED INSPECTION SIGNATURE	MARK UP ANY REJECTED LOCATION DATE

MARK UP ANY REJECTED LOCATION

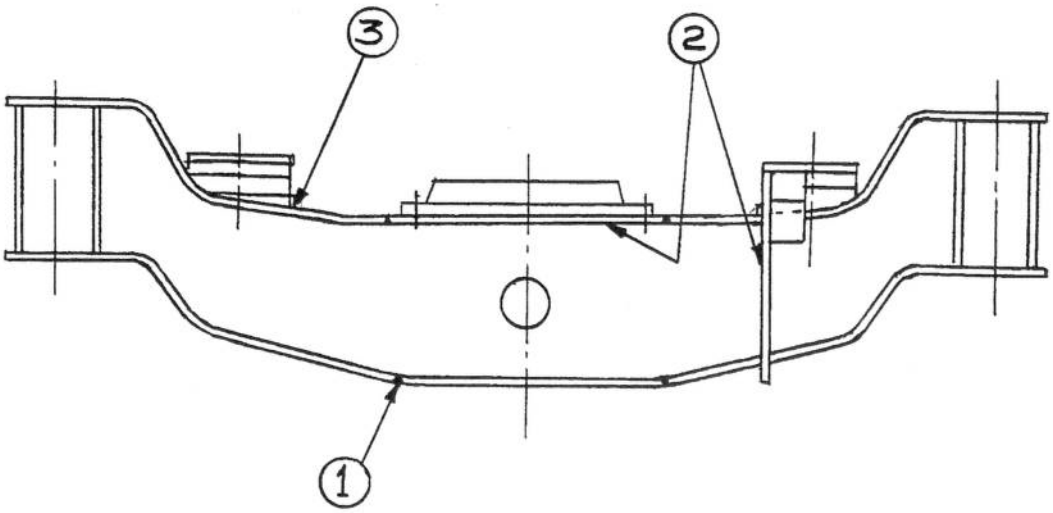


Part 3 Inspection Record Sheets (Figure 12 Disc brakes)

VEHICLE NUMBER	BOGIE NUMBER
INSPECTION AREA	
1. CROSS WELDS IN BOTTOM PLATE	3. WELD BETWEEN THE BOTTOM OF THE SIDE BEARERS & BOLSTER.
2. BOLSTER SIDE PLATES AT TOP & ALL BRAKE BRACKETS	
BOLSTER SIDE 1 MARK UP ANY REJECTED LOCATION BOGIE FAILED / PASSED INSPECTION SIGNATURE DATE	

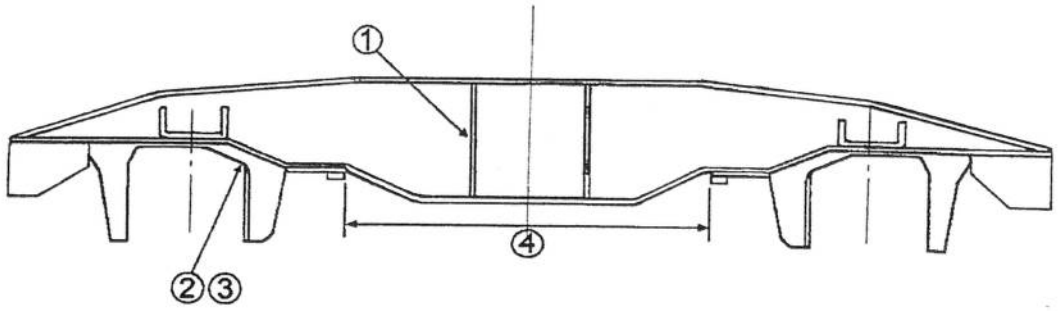


BOLSTER SIDE 1 MARK UP ANY REJECTED LOCATION BOGIE FAILED / PASSED INSPECTION SIGNATURE DATE



Part 3 Inspection Record Sheets (Figure13 Disc Brakes)

VEHICLE NUMBER	BOGIE NUMBER
INSPECTION AREA	
1. VERTICAL WELDS AT CLOSEURE PLATE	3. WELD AT HORN GUIDE FACE PLATE.
2. HORN GUIDE SIDEPLATES	4. BOTTOM PLATE AND WELDS, SIDE FRAME BOTH SIDES.
SIDEFRAME 1 BOGIE FAILED / PASSED INSPECTION SIGNATURE	MARK UP ANY REJECTED LOCATION DATE



SIDEFRAME 2 BOGIE FAILED / PASSED INSPECTION SIGNATURE	MARK UP ANY REJECTED LOCATION DATE